EXHIBIT No. 4

ARCCA, INCORPORATED
3455 Thorndyke Ave W, Suite 206
SEATTLE, WA 98119
PHONE 877-942-7222 **FAX** 206-547-0759
www.arcca.com

August 20, 2018

Roy Umlauf, Esquire
Forsberg & Umlauf PS
901 Fifth Avenue, Suite 1400
Seattle, WA 98164

Re: *Reef, Brian v. Target Corp.*
Claim No.: 1523.0091
ARCCA Case No.: 3481-012

Dear Mr. Umlauf:

Thank you for the opportunity to participate in the above-referenced matter. Your firm retained ARCCA, Incorporated to evaluate the subject incident in relation to the forces and claimed biomechanical failures involved in the incident of Brian Reef. This analysis is based on information currently available to ARCCA. However, ARCCA reserves the right to supplement or revise this report if additional information becomes available to us.

The opinions given in this report are based on my analysis of the materials available, using scientific and generally accepted biomechanical methodologies.[1,2,3,4] The opinions are also based on my education, background, knowledge, and experience in the fields of human kinematics and biomechanics. I have a Bachelor of Science degree in Mechanical Engineering, a Master of Science degree in Biomedical Engineering, and have completed the educational requirements for my Doctor of Philosophy degree in Biomedical Engineering. I am a member of the Society of Automotive Engineers, the Association for the Advancement of Automotive Medicine, the American Society of Safety Engineers, and the American Society of Mechanical Engineers.

I have designed, developed, and tested kinematic models of the human cervical spine and head. My testing and research have been performed with both anthropomorphic test devices and human subjects. As such, I am very familiar with the theory and application of human tolerance to inertial and impact loading, as well as the techniques and processes for evaluating human kinematics and biomechanical failure potential.

Incident Description:

According to the available documents, on April 11, 2015 Mr. Brian Reef was exiting a Target in Gig Harbor, Washington. A Target employee was pushing a dresser on a cart, also exiting the store. Mr. Reef entered the store foyer, paused for another patron exiting the store in front of him, turned slightly to pass the Target employee, and was contacted in the posterior right calf by the dresser as it fell off of the cart.

---

1 Nahum, A.M., & Gomez, M.A. (1994). *Injury Reconstruction: The Biomechanical Analysis of Accidental Injury* (No. 940568). SAE Technical Paper.

2 Robbins, D.H., Melvin, J.W., Huelke, D.F., & Sherman, H.W. (1983). *Biomechanical accident investigation methodology using analytical techniques* (No. SAE 831609). SAE Technical Paper.

3 King, A.I. (2000). Fundamentals of Impact Biomechanics: Part I-Biomechanics of the Head, Neck, and Thorax. *Annual Review of Biomedical Engineering*, *2*(1), 55-81.

4 King, A.I. (2001). Fundamentals of Impact Biomechanics: Part II-Biomechanics of the Abdomen, Pelvis, and Lower Extremities." *Annual Review of Biomedical Engineering*, *3*(1), 27-55.

Information Reviewed:

In the course of my analysis, I reviewed the following materials:

- Security camera video footage of the subject incident
- Guest Incident Report, *Report No. 172948G*
- Recorded statement transcript of Brian Reef [May 8, 2015]
- Declaration of Dr. N. Jarrod Durkee [July 6, 2018]
- Declaration of Farzad Massoudi, M.D. [June 9, 2018]
- Deposition excerpt of Brian Reef
- Video deposition excerpts of Brian Reef
- Medical Records pertaining to Brian Reef
- Publicly available literature, including, but not limited to, the documents cited within this report, learned treatises, text books, technical journals, and scientific standards.

Biomechanical Analysis:

The method used to conduct a biomechanical analysis is well defined and accepted in the scientific community and is an established approach to assessing biomechanical failure causation as documented in the technical literature.[5,6,7,8,9] Within the context of this incident, my analyses consisted of the following steps:

1. Identify the biomechanical failures that Mr. Reef claims were caused by the subject incident on April 11, 2015;
2. Quantify the nature of the subject incident in terms of the forces and accelerations experienced by Mr. Reef;
3. Determine Mr. Reef's kinematic responses as a result of the subject incident;
4. Define the biomechanical failure mechanisms known to cause the reported biomechanical failures and determine whether the defined biomechanical failure mechanisms were created during the subject incident;
5. Evaluate Mr. Reef's personal tolerances in the context of his pre-incident condition to determine to a reasonable degree of scientific certainty whether a causal relationship exists between the subject incident and his reported biomechanical failures.

---

5 Robbins, D.H., Melvin, J.W., Huelke, D.F., & Sherman, H.W. (1983). *Biomechanical accident investigation methodology using analytical techniques* (No. SAE 831609). SAE Technical Paper.

6 Nahum, A.M., & Gomez, M.A. (1994). *Injury Reconstruction: The Biomechanical Analysis of Accidental Injury* (No. 940568). SAE Technical Paper.

7 King, A.I. (2000). Fundamentals of Impact Biomechanics: Part I-Biomechanics of the Head, Neck, and Thorax. *Annual Review of Biomedical Engineering*, *2*(1), 55-81.

8 King, A.I. (2001). Fundamentals of Impact Biomechanics: Part II-Biomechanics of the Abdomen, Pelvis, and Lower Extremities." *Annual Review of Biomedical Engineering*, *3*(1), 27-55.

9 Whiting, W. C., & Zernicke, R. F. (2008). *Biomechanics of Musculoskeletal Injury*. Human Kinetics.

If, the subject incident did not create the biomechanical failure mechanisms associated with the reported biomechanical failures, then a causal link to the subject incident cannot be established.

Biomechanical Failure Summary:

The available documents indicate Mr. Reef attributes the following biomechanical failures as a result of the subject incident:

- Lumbar Spine
    - L5-S1 herniated nucleus pulposus

Damage and Incident Severity:

The cabinet that fell on Mr. Reef's leg was a wood composite frame, painted hardwood cabinet with a weight of 43 lbs. The cabinet was 31.0 inches in height, 31.7 inches in width, and 14.0 inches in depth.

Figure 1 – Digital image exemplar of the cabinet involved in the subject incident[10].

Video surveillance footage depicts Mr. Reef entering the store foyer carrying a bag in his right hand (Figure 2). A woman with two children and a cart are seen exiting the store to Mr. Reef's right, and the Target employee with the dresser is in front of Mr. Reef.

[10] https://www.target.com/p/windham-2-door-accent-cabinet-shell-threshold-153/-/A-14372249. Accessed August, 2018.

Figure 2 – Screen capture of surveillance footage prior to the subject incident.

Mr. Reef proceeds into the foyer, turning slightly to his right to go around the dresser and cart. He temporarily pauses as he waits for other patrons to exit the store ahead of him.

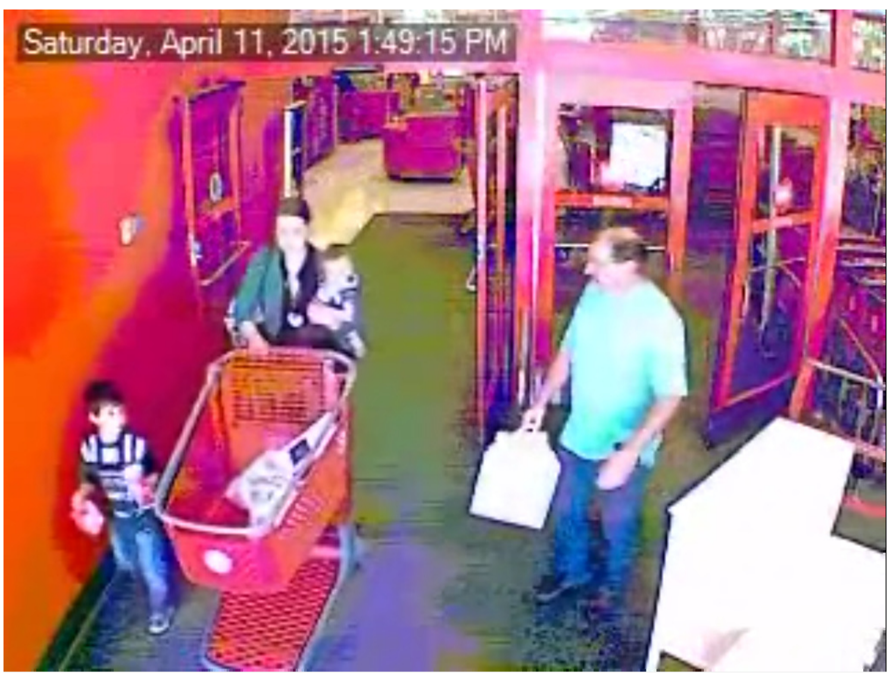

Figure 3 – Screen capture of surveillance footage prior to the subject incident.

The dresser on the cart then tips over and contacts Mr. Reef at his right calf (Figure 4). The dresser temporarily entraps Mr. Reef's right calf, until he pulls his right leg from under the dresser and steps forward. He continues to take approximately 2 more steps toward the adjacent wall before slowly moving to the ground on his knees, using the wall as support with his left arm. He is seen grabbing is lower right calf.

Figure 4 – Screen capture of surveillance footage during the subject incident.

In his recorded statement, Mr. Reef indicated that the dresser *"struck me from behind and took me out and I went straight to the ground"*. He continued, indicating the contact *"basically threw me to the ground in an awkward way kind of whipped me down into the, into the ground"*. The video surveillance footage indicates that approximately 2 seconds passed from contact with the dresser until Mr. Reef reached the adjacent wall and lowered himself to the ground. Again, Mr. Reef took several steps, covering several feet, before lowering to the ground while supporting himself with his hand against the wall. There is no indication of a fall as a direct result of the contact from the dresser, nor is there any indication of a "whipping" motion that resulted in falling "straight to the ground".

Mr. Reef testified that the dresser initially contacted his left calf, but ultimately contacted his right side. He further testified, *"the thrust of my legs going forward and my back going back like this and trying to catch myself"*. The surveillance footage depicts Mr. Reef in a double-support phase of gait at the time of contact (Figure 5).

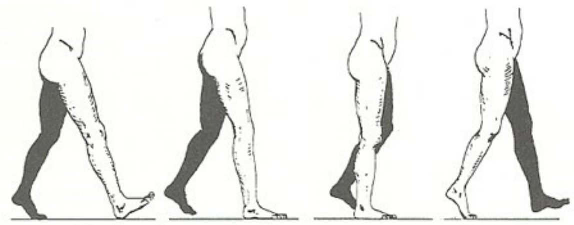

Figure 5: Example phases of gait cycle. The dark leg is non-weight bearing in swing phase, while the light leg is in stance phase and weight bearing.

In this phase, body weight is distributed over both feet, prior to initiating the toe-off phase. In this position, as the weight of the dresser falls onto Mr. Reef's right calf, he is still able to support his body weight on his left leg. This allows him to balance and pull his right leg from under the dresser. Mr. Reef's kinematics depict a controlled gait disturbance that allows him to step away from the dresser and control himself toward the ground.

The report prepared by Dr. Massoudi indicates that the subject incident caused *"a buckling movement of his legs and back"*. There is no indication of Mr. Reef's left or right knee "buckling" as a result of contact, nor and "buckling movement" of his back. Dr. Massoudi further states that *"If any of the body's protective mechanisms are inhibited, then any amount of force, in this instance a 40 pound wooden dresser, acting at a specific level in the spine can cause significant and lasting damage"*. The surveillance footage, and Mr. Reef's own testimony, indicate the dresser contacted Mr. Reef's lower calves, not his back. There is no significant motion of either the knee, hip, or spine as a result of this impact. There was no direct impact loading to the lower back and no significant inertial loading to the lower back.

The available medical records indicate Mr. Reef weighed approximately 201 pounds, was 68 inches in height, and 46 years old at the time of the incident. The weight of the dresser contacting Mr. Reef would have resulted in approximately a 0.2g impact. Studies have shown a force as low as 7 lbs., which is approximately 3.4% of Mr. Reef's bodyweight, can result in a subject taking a step to recover. Further, studies have shown perturbations on the order of 0.3g lateral can cause the subject to fall to the ground.[11] As depicted in the surveillance footage, Mr. Reef does not fall directly as a result of the contact. If fact, there is no significant forward movement of his right foot and lower leg; it remained planted on the floor until he moved it voluntarily from beneath the dresser. Finally, he took several steps before lowering his body to the ground in a controlled fashion.

The acceleration experienced due to gravity is 1g. This means that Mr. Reef experiences 1g of loading while in a sedentary state. Therefore, Mr. Reef experiences an essentially equivalent acceleration load on a daily basis while in a non-sedentary state as compared to the subject incident. The joints of the human body are regularly and repeatedly subjected to a wide range of forces during daily activities. Almost any movements beyond a sedentary state can result in short duration joint forces of multiple times an individual's body weight. Events, such as slowly climbing stairs, standing on one leg, or

---

[11] B.E. Make, W.E. McIlroy, and S.D. Perry (1995). Influence of Lateral Destabilization on Compensatory Stepping Responses. *Journal of Biomechanics* **29(3)**: 343-353.

rising from a chair, are capable of such forces.[12] More dynamic events, such as running, jumping, or lifting weights, can increase short duration joint load to as much as ten to twenty times body weight. Yet, because of the remarkable resiliency of the human body, these joints can undergo many millions of loading cycles without significant degeneration.

Evaluation of Biomechanical Failure Mechanisms:

Based upon the review of the available incident data, the relevant incident severity resulted in accelerations well within the limits of human tolerance and typically within the range of normal, daily activities. The energy imparted to Mr. Reef was well within the limits of human tolerance and well below the acceleration levels that he likely experienced during normal daily activities. Without exceeding these limits, or the normal range of motion, there is no biomechanical failure mechanism present to causally link his reported biomechanical failures and the subject incident.[13,14]

From a biomechanical perspective, causation between an alleged incident and a claimed biomechanical failure is determined by addressing two issues or questions:

1. Did the subject incident load the body in a manner known to cause damage to a body part? That is, did the subject event create a known biomechanical failure mechanism?
2. If a biomechanical failure mechanism was present, did the subject event load the body with sufficient magnitude to exceed the tolerance or strength of the specific body part? That is, did the event create a force sufficiently large to cause damage to the tissue?

Lumbar Spine

The available documents indicate Mr. Reef attributes an L5-S1 herniated disc to the subject incident. Soft-tissue biomechanical failure refers to a sprain/strain type failure of the tissue. A lumbar MRI noted a 12 mm disc fragment and disc herniation at L5-S1compressing the nerve root and thecal sac. A microdiscectomy of the L5-S1 level was performed on May 6, 2015, in which a L5-S1 herniated nucleus pulposus was noted.

Disc biomechanical failure can result from chronic degeneration of the disc itself or from acute insult, that is, a single event wherein forces are applied to the disc at magnitudes beyond its capacity or strength. Based upon previous research, the accepted mechanism for acute intervertebral disc bulge, protrusion, herniation, or tearing involves a combination of hyperflexion or hyperextension and lateral bending with an application of a sudden compressive load.[15] In the absence of this acute biomechanical failure mechanism for cervical disc failure, scientific investigations have shown that the above lumbar disc diagnoses can be the result of the normal aging process.[16,17] The primary mechanism for this type of biomechanical failure occurs when a sudden application of a compressive force with associated bending that exceeds the limits of the disc tissue strength. [18,19]

---

12 Mow, V.C. and Hayes, W.C. (1991). Basic Orthopaedic Biomechanics. Raven Press, New York.
13 Mertz, H.J. and Patrick, L.M. (1967). *Investigation of The Kinematics and Kinetics of Whiplash*. (No. 670919). SAE Technical Paper.
14 Mertz, H.J. and Patrick, L.M. (1971). *Strength and Response of The Human Neck*. (No. 710855). SAE Technical Paper.
15 White III, A. A. and M. M. Panjabi (1990). Clinical Biomechanics of the Spine. Philadelphia, J.B. Lippincott Company.
16 Kambin, P., Nixon, J.E., Chait, A., et al. (1988). "Annular Protrusion: Pathophysiology and Roentgenographic Appearance." Spine 13(6): 671-675.
17 Roh, J.S., Teng, A.L., Yoo, J.U., et al., (2005). "Degenerative Disorders of the Lumbar and Cervical Spine." Orthopedic Clinics of North America 36: 255-262.
18 White III, A. A. and M. M. Panjabi (1990). Clinical Biomechanics of the Spine. Philadelphia, J.B. Lippincott Company.
19 Adams, M.A., and Hutton, W.C. (1982). "Prolapsed Intervertebral Disc: A Hyperflexion Injury." Spine. 7: 184-191.

As mentioned previously, the acceleration experienced by Mr. Reef during the subject incident was less than 1.0g. Given the low forces and accelerations involved in the subject incident, little motion of his lumbar spine would have occurred, which is confirmed by the video surveillance footage. The lack of relative motion would indicate a lack of compressive, tensile, shear, or torsional loads to the lumbar spine; thus it would not be possible to load the tissue to its physiological limit where tissue failure, or biomechanical failure, would occur.

As noted above, the mechanism requires compressive load to the spine. In this event that would require the force of the dresser falling, after contacting his lower leg in a downward fashion, to reverse direction, travel up his leg, travel through his pelvis, and to then enter his lower back. This is contrary to the most basic laws of physics and human physiology.

Multiple investigations have shown that apparently benign tasks such as flexion of the upper body while standing, body position changes, lifting/laying down a weight, along with crouching and arching the back can generate loads that are comparable to or greater than those resulting from the subject incident.[20,21,22,23] Further studies of lumbar accelerations during activities of daily living found accelerations for activities such as sitting, walking, and jumping off a step to be comparable to or greater than the subject incident.[24,25] Peer-reviewed technical literature and learned treatises have demonstrated that the compressive forces experienced during typical activities of daily living, such as stretching/strengthening exercises typically associated with physical therapy, were comparable to or greater than those associated with the subject incident.[26] According to the available documents, Mr. Reef was capable of performing daily activities. Mr. Reef indicated that he climbed palm trees on his property to prune branches, and played basketball, racquetball, and golf. A segmental analysis of Mr. Reef demonstrated that as he lifted objects during daily tasks, the forces applied to his lower spine would have been comparable to or greater than those during the subject incident.[27,28,29] In fact, golfing has been shown to produce as much as 6 times body weight through the lumbar spine.[30,31]

Based upon the review of the available incident data and the results cited in the technical literature as described above, the kinematics or occupant motions caused by this incident were well within the normal range of motion associated with the lumbar spine. Finally, the forces created by the incident were well within the limits of human tolerance for the lumbar spine and were within the range

[20] Rohlmann, A., Claes, L.E., Bergmann, G., Graichen, F., Neef, P., & Wilke, H.J. (2001). Comparison of intradiscal pressures and spinal fixator loads for different body positions and exercises. *Ergonomics*, *44*(8), 781-794.

[21] Rohlmann, A., Petersen, R., Schwachmeyer, V., Graichen, F., & Bergmann, G. (2012). Spinal loads during position changes. *Clinical Biomechanics*, *27*(8), 754-758.

[22] Rohlmann, A., Zander, T., Graichen, F., & Bergmann, G. (2013). Lifting up and laying down a weight causes high spinal loads. *Journal of Biomechanics*, *46*(3), 511-514.

[23] Morris, J.M., Lucas, D.B., Bresler, B., (1961). “Role of the Trunk in Stability of the Spine.” The Journal of Bone and Joint Surgery, American 43-A(3): 327-351.

[24] Ng, T.P., Bussone, W.R., Duma, S.M., & Kress, T.A. (2006). Thoracic and lumbar spine accelerations in everyday activities. *Biomedical Sciences Instrumentation*, *42*, 410.

[25] Manoogian, S.J., Funk, J.R., Cormier, J.M., et al., (2010). Evaluation of Lumbar and Lumbar Accelerations of Volunteers in Vertical and Horizontal Loading Conditions (SAE 2010-01-0146). Warrendale, PA, Society of Automotive Engineers.

[26] Kavcic, N., Grenier, S., & McGill, S.M. (2004). Quantifying tissue loads and spine stability while performing commonly prescribed low back stabilization exercises. *Spine*, *29*(20), 2319-2329.

[27] Nordin, M., and Frankel, V.H., (2001). Basic Biomechanics of the Musculoskeletal System, Third Edition. Philadelphia, PA, Lippincott Williams & Wilkins.

[28] Morris, J.M., Lucas, D.B., Bresler, B., (1961). “Role of the Trunk in Stability of the Spine.” The Journal of Bone and Joint Surgery, American 43-A(3): 327-351.

[29] Chaffin, DB, Andersson, GBJ, Maring, BJ, (1999) Occupational Biomechanics, Third Edition, Wiley-Interscience

[30] Lim, Y.T. et al. (2012). Lumbar spinal loads and muscle activity during a golf swing. Sports Biomechanics, 11(2): 197-211.

[31] Park, S.K. et al. (2010). Analysis of Lumbar Spine Load during Golf Swing in Pro Golfer. Journal of International Academy of Physical Therapy Research, 1:162-168.

typically seen in normal, daily activities. As this event did not create the required biomechanical failure mechanism and did not create forces that exceeded the personal tolerance limits of Mr. Reef, a causal link between the subject incident and claimed lumbar biomechanical failures cannot be made.

Personal Tolerance Values

The records indicate Mr. Reef worked as a director of sales, and regularly took flights for travel. As mentioned previously, he was capable of climbing 10-12 trees on his property to trim braches. He enjoyed riding rollercoasters, swimming, gardening, and playing basketball, racquetball, and golf. Daily activities can produce greater movement, or stretch, to the soft tissues of Mr. Reef and produce comparable, if not greater, forces applied to the body regions where biomechanical failures are claimed.

It is important to note that the peer-reviewed and generally-accepted technical articles cited throughout this report are included as support for the methodologies employed and the conclusions developed through my independent analysis of the subject incident. These scientific studies were not cited to simply be extrapolated to the subject incident and provide general opinions regarding the likelihood of biomechanical failure. My conclusions are specific to the characteristics of the subject incident. My evaluation regarding the lack of a causal relationship between Mr. Reef's reported biomechanical failures and the subject incident incorporated thorough analyses of the incident severity, occupant response, biomechanical failure mechanisms, and an understanding of the unique personal tolerance level of Mr. Reef using peer-reviewed and generally-accepted methodologies.

Conclusions:

Based upon a reasonable degree of scientific and biomechanical certainty, I conclude the following:

1. On July 18, 2014, Ms. Brian Reef was a patron of a Target in Gig Harbor, Washington, when he was contacted on the right calf by a dresser.
2. The severity of the subject incident was less than 1.0g to Mr. Reef's lower calves.
3. The acceleration experienced by Mr. Reef was within the limits of human tolerance and comparable to that experienced during various daily activities.
4. There is no biomechanical failure mechanism present in the subject incident to account for Mr. Reef's claimed lumbar biomechanical failures. As such, a causal relationship between the subject incident and the lumbar biomechanical failures cannot be made.

If you have any questions, require additional assistance, or if any additional information becomes available, please do not hesitate to call.

This analysis is intended for use by the addressee, who assumes sole responsibility for any dissemination of this document.

Sincerely,

Bradley W. Probst, MSBME
Senior Biomechanist